CLAIMS

What is claimed is:

1. An internal beam device configured for a buoyancy system for an offshore oil platform, the device comprising:

a) an elongated, vertical stem extending substantially along the buoyancy system and having an axially disposed bore configured to receive at least one riser therethrough;

b) a plurality of webs, extending substantially along a length of the elongated stem, having inner edges attached to the stem and extending radially outwardly therefrom to opposite outer edges; and

c) a plurality of transverse flanges, attached to the outer edges of the webs, the stem, the webs, and the transverse flanges forming a structural beam configured to withstand loads between the buoyancy system and the oil platform.

2. A device in accordance with claim 1, wherein the plurality of webs includes at least four webs oriented in at least two different orientations.

3. A device in accordance with claim 1, wherein the plurality of webs further includes:

a) a first pair of webs disposed on opposite sides of the stem, and

b) a second pair of webs disposed on opposite sides of the stem and oriented perpendicularly to the first pair of webs.

4. A device in accordance with claim 1, wherein the webs include an array of apertures formed therein along a length of the webs.

5. A device in accordance with claim 1, further comprising:

a plurality of bulkheads, disposed around the stem and oriented transverse to both the stem and the plurality of webs, and extending between adjacent webs.

6. A device in accordance with claim 1, wherein the stem, the webs and the transverse flanges include a plurality of modular sections joined end-to-end in series.

7. A device in accordance with claim 6, wherein each of the modular sections includes a plurality of fins extending therefrom towards the plurality of fins of an adjacent modular section;

and further comprising a plurality of splice plates, each secured to a pair of adjacent fins, to secure the adjacent fins, and thus the adjacent modular sections, together.

8. A device in accordance with claim 6, wherein one modular section is joined to an adjacent modular section by a connection including opposing grooves with one groove formed in the one modular section and another groove formed in the adjacent modular section, the connection further including a locking member disposed in the opposing grooves.

9. A device in accordance with claim 1, further comprising buoyancy means, couplable to the stem, for containing a buoyant material and securing the buoyant material to the stem.

10. A device in accordance with claim 1, further comprising:

a) a plurality of compartments, couplable to the stem and disposable between the webs; and

b) buoyant material disposed in the plurality of compartments.

11. A device in accordance with claim 10, wherein the plurality of compartments circumscribe the stem defining adjacent lateral compartments; and wherein the adjacent lateral compartments are operatively interconnected by air lines.

12. A device in accordance with claim 10, further comprising:

a) an air management apparatus including at least one air line configured to be coupled to a pressurized air source, and couplable to the compartments; and

b) a channel, formed between at least one of the compartments, an adjacent web, and an adjacent flange, the air line extending through the channel.

13. A device in accordance with claim 10, further comprising:

a) a plurality of ribs formed along the stem; and

b) a plurality of mating grooves formed in the compartments, the ribs and the grooves intermeshing such that a buoyancy force of the compartment is transferred to the stem through the ribs.

14. A device in accordance with claim 13, further comprising:

a) a gap, formed between a rib and a groove; and

b) a shim, disposed the gap.

15. A device in accordance with claim 10, further comprising:

a) a plurality of arcuate indentations formed in an outer wall of the enclosures; and

b) a plurality of retention straps, attached to the structural beam and engaging the enclosures at the indentations.

16. A device in accordance with claim 10, wherein each of the plurality of compartments has a shape that substantially fills a space between adjacent webs, including opposite side walls disposable adjacent the webs, an inner arcuate wall disposable adjacent the stem, and an outer arcuate wall opposite the inner arcuate wall.

17. A device in accordance with claim 10, wherein each of the plurality of compartments includes a one-piece, continuous liner encapsulated in a fiber composite matrix laminate.

18. A device in accordance with claim 10, wherein each of the plurality of compartments includes a one-piece, continuous liner formed of a thermoplastic material.

19. A device in accordance with claim 10, wherein each of the plurality of compartments includes pigment to color the material to facilitate inspection.

20. A device in accordance with claim 10, wherein at least one of the compartments includes 1) a side wall disposable adjacent the web, 2) an outer wall, and 3) and an edge wall between the side wall and the outer wall, the edge wall forming an oblique angle with respect to the web, a longitudinal channel being formed between the web, the flange, and the edge wall; and further comprising an air line extending through the longitudinal channel.

21. A device in accordance with claim 10, wherein at least one of the buoyancy modules includes 1) a bottom wall extending between adjacent webs, 2) an outer wall, and 3) and an edge wall between the bottom wall and the outer wall, the edge wall forming an oblique angle with respect to the flange, a circumferential indentation being formed between the bottom wall and the edge wall; and further comprising an air line extending in the circumferential indentation.

22. A device in accordance with claim 10, wherein the compartments are configured to be pressurized with air; wherein the compartments include side walls disposable adjacent the webs; and wherein the side walls are flexible and bear against the webs to apply lateral loads to the webs when the compartments are pressurized.

23. A device in accordance with claim 10, further comprising:

an air outlet pipe, disposed in each of the compartments, and extending from a bottom of the compartment to an intermediate point along a length of the compartment.

24. A device in accordance with claim 1, wherein the webs or the flanges have a thickness that varies along the length of the buoyancy system.

25. A buoyancy system configured for an offshore oil platform, the system comprising:

a) an elongated, vertical stem extending substantially along the buoyancy system and having an axially disposed bore configured to receive at least one riser therethrough;

b) a plurality of webs, extending substantially along a length of the elongated stem, having inner edges attached to the stem and extending radially outwardly therefrom to opposite outer edges;

c) a plurality of transverse flanges, attached to the outer edges of the webs, the stem, the webs, and the transverse flanges forming a structural beam configured to withstand loads between the buoyancy system and the oil platform; and

d) at least one enclosure, coupled to the stem, and containing a buoyant material configured to produce a buoyancy force.

26. A system in accordance with claim 25, wherein:

a) the plurality of webs includes at least four webs oriented in at least two different orientations, the four webs forming four sections disposed circumferentially around the stem and extending axially along the stem; and

b) the enclosure includes at least four separate enclosures disposed in the four sections.

27. A system in accordance with claim 25, wherein the plurality of webs further includes:

a) a first pair of webs disposed on opposite sides of the stem, and

b) a second pair of webs disposed on opposite sides of the stem and oriented perpendicularly to the first pair of webs to form four sections disposed circumferentially around the stem.

28. A system in accordance with claim 25, further comprising:

a plurality of bulkheads, disposed around the stem and oriented transverse to both the stem and the plurality of webs, and extending between adjacent webs.

29. A system in accordance with claim 25, wherein the stem, the webs and the transverse flanges include a plurality of modular sections joined end-to-end in series.

30. A system in accordance with claim 29, wherein each of the modular sections includes a plurality of fins extending therefrom towards the plurality of fins of an adjacent modular section; and further comprising a plurality of splice plates, each secured to a pair of adjacent fins, to secure the adjacent fins, and thus the adjacent modular sections, together.

31. A system in accordance with claim 29, wherein one modular section is joined to an adjacent modular section by a connection including opposing grooves with one groove formed in the one modular section and another groove formed in the adjacent modular section, the connection further including a locking member disposed in the opposing grooves.

32. A system in accordance with claim 25, wherein the enclosure further includes a plurality of compartments disposed between the webs and couplable to the stem.

33. A system in accordance with claim 32, wherein the plurality of compartments circumscribe the stem defining adjacent lateral compartments; and wherein the adjacent lateral compartments are operatively interconnected by air lines.

34. A system in accordance with claim 32, further comprising:

a) an air management apparatus including at least one air line configured to be coupled to a pressurized air source, and couplable to the compartments; and

b) a channel, formed between at least one of the compartments, an adjacent web, and an adjacent flange, the air line extending through the channel.

35. A system in accordance with claim 32, further comprising:

a) a plurality of ribs formed along the stem; and

b) a plurality of mating grooves formed in the compartments, the ribs and the grooves intermeshing such that a buoyancy force of the compartment is transferred to the stem through the ribs.

36. A system in accordance with claim 35, further comprising:

a) a gap, formed between a rib and a groove; and

b) a liquid shim, disposed the gap.

37. A system in accordance with claim 32, further comprising:

a) a plurality of arcuate indentations formed in an outer wall of the enclosures; and

b) a plurality of retention straps, attached to the structural beam and engaging the enclosures at the indentations.

38. A system in accordance with claim 32, wherein each of the plurality of compartments has a shape that substantially fills a space between adjacent webs, including opposite side walls disposable adjacent the webs, an inner arcuate wall disposable adjacent the stem, and an outer arcuate wall opposite the inner arcuate wall.

39. A system in accordance with claim 32, wherein each of the plurality of compartments includes a one-piece, continuous liner encapsulated in a fiber composite matrix laminate.

40. A system in accordance with claim 32, wherein each of the plurality of compartments includes a one-piece, continuous liner formed of a thermoplastic material.

41. A system in accordance with claim 25, wherein the webs or the flanges have a thickness that varies along the length of the buoyancy system.

42. An offshore oil platform system, comprising:

a) an oil platform configured to float partially or wholly submerged;

b) at least one riser, operatively couplable to the oil platform and configured to extend from the oil platform to a seabed and to conduct oil or gas therethrough; and

c) a buoyancy system, movably disposable in the oil platform and configured to apply a buoyancy force to the at least one riser to support the riser, the buoyancy system including:

1) an elongated internal beam, configured to withstand loads between the oil platform and the buoyancy system, extending substantially along the buoyancy system, having a) an elongated stem with an axially disposed bore configured to receive at least one riser therethrough, b) a plurality of webs, extending substantially along a length of the elongated stem, having inner edges attached to the stem and extending radially outwardly therefrom to opposite outer edges, and c) a plurality of transverse flanges, attached to the outer edges of the webs; and

2) at least one enclosure, coupled to the stem, and containing a buoyant material configured to produce a buoyancy force when submerged.

43. A system in accordance with claim 42, wherein the oil platform further includes a partially or wholly submerged hull having a framework with at least one vertically oriented shaft formed therein in which the buoyancy system is movably disposed; and wherein the internal beam has a width that substantially spans a width of the shaft.

44. A system in accordance with claim 42, wherein:

a) the plurality of webs includes at least four webs oriented in at least two different orientations, the four webs forming four sections disposed circumferentially around the stem and extending axially along the stem; and

b) the enclosure includes at least four separate enclosures disposed in the four sections.

45. A system in accordance with claim 42, wherein the plurality of webs further includes:

a) a first pair of webs disposed on opposite sides of the stem, and

b) a second pair of webs disposed on opposite sides of the stem and oriented perpendicularly to the first pair of webs to form four sections disposed circumferentially around the stem.

46. A system in accordance with claim 42, further comprising:

a plurality of bulkheads, disposed around the stem and oriented transverse to both the stem and the plurality of webs, and extending between adjacent webs.

47. A system in accordance with claim 42, wherein the stem, the webs and the transverse flanges include a plurality of modular sections joined end-to-end in series.

48. A system in accordance with claim 47, wherein each of the modular sections includes a plurality of fins extending therefrom towards the plurality of fins of an adjacent modular section; and further comprising a plurality of splice plates, each secured to a pair of adjacent fins, to secure the adjacent fins, and thus the adjacent modular sections, together.

49. A system in accordance with claim 47, wherein one modular section is joined to an adjacent modular section by a connection including opposing grooves with one groove formed in the one modular section and another groove formed in the adjacent modular section, the connection further including a locking member disposed in the opposing grooves.

50. A system in accordance with claim 42, wherein the enclosure further includes a plurality of compartments disposed between the webs and couplable to the stem.

51. A system in accordance with claim 50, further comprising:

a) an air management apparatus including at least one air line configured to be coupled to a pressurized air source, and couplable to the compartments; and

b) a channel, formed between at least one of the compartments, an adjacent web, and an adjacent flange, the air line extending through the channel.

52. A system in accordance with claim 50, further comprising:

a) a plurality of ribs formed along the stem; and

b) a plurality of mating grooves formed in the compartments, the ribs and the grooves intermeshing such that a buoyancy force of the compartment is transferred to the stem through the ribs.

53. A system in accordance with claim 50, further comprising:

a) a plurality of arcuate indentations formed in an outer wall of the enclosures; and

b) a plurality of retention straps, attached to the structural beam and engaging the enclosures at the indentations.

54. A system in accordance with claim 50, wherein each of the plurality of compartments has a shape that substantially fills a space between adjacent webs, including opposite side walls disposable adjacent the webs, an inner arcuate wall disposable adjacent the stem, and an outer arcuate wall opposite the inner arcuate wall.

55. A system in accordance with claim 50, wherein each of the plurality of compartments includes a one-piece, continuous liner encapsulated in a fiber composite matrix laminate.

56. A system in accordance with claim 50, wherein each of the plurality of compartments includes a one-piece, continuous liner formed of a thermoplastic material.

57. A frame for a buoyancy system used to support the weight of a riser on an offshore oil platform, comprising:

a series of frame sections connected end-to-end for a length of the buoyancy system to form a continuous frame configured to support multiple buoyancy elements.

58. A frame in accordance with claim 57, further comprising:

a plurality of buoyancy elements, coupled to the frame.

59. A frame for a buoyancy system used to support the weight of a riser on an offshore oil platform, comprising:

a plurality of sections connected end-to-end for the length of the buoyancy system, each section comprising:

a stem extending axially through the section and having a bore for receiving at least one riser;

at least four webs extending radially from the stem and extending substantially the entire length of the section, the stem and the webs being adapted to withstand forces applied to the buoyancy system during use; and

a bulkhead disposed at each end of each section and connected to ends of the at least four webs, the bulkheads of adjacent sections including means for securing the two sections together to provide a framework for a buoyancy system having a continuous frame for withstanding the loads applied to the buoyancy system during use.